USING AN INVERSION AI, GORITHM TO RETRIEVE PARAMETERS AND MONITOR CHANGES OVER FORESTED AREAS FROM SAR DATA

Mahta Moghaddam
Jet Propulsion laboratory, California Institute of Technology
MS 300-235
4800 Oak Grove Drive
Pasadena, CA 91109, USA

In this work, the application of an inversion algorithm based on a nonlinear optimization technique to retrieve forest parameters from multifrequency polarimetric SAR data is discussed. The approach discussed here allows for retrieving and monitoring changes in forest parameters in a quantitative and systematic fashion using SAR data. The parameters to be inverted directly from the data are the electromagnetic scattering properties of the forest components such as their dielectric constants and size characteristics. Once these are known, attributes such as canopy moisture content can be obtained, which are useful in the ecosystem models. The inversion algorithm is an iterative procedure and requires a priori estimates of the unknowns as well as knowledge of the stochastic properties of measured data, Parametric models are used to relate the unknowns describing forest physical parameters to SAR data. An optimization technique is then used to obtain the best set of parameters that produce the measured data given the parametric models. These models are derived from a numerical discrete-component forest scattering model for parameters over specified ranges. The numerical scattering model includes the major scattering mechanisms responsible for the total SAR backscatter. Here, we concentrate on the branch-layer volume scattering mechanism. The parametric models mentioned above are generated for the case where a small number of branch layer parameters are allowed to vary (one or two) while other parameters are assumed known from, e.g., ground-truth measurements. As such, the inversion algorithm is suitable for monitoring temporal changes with respect to the unknown parameters for forests under various environmental conditions. For example, it can be used to quantitatively characterize the moisture state of the branch-layer in a given forest on a daily, weekly, seasonal, etc, basis. The inversion algorithm is tested and verified by using synthetic data initially. It is then applied to actual SAR data. Among the test sites are some forested areas in Oregon which were used in the OTTER experiment, and for which SAR data over different seasons exist. The results are in agreement with the expected values, although it is observed that as the number of unknown parameters increases, the accuracy of inversion decreases.

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